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(54) **FAIRING FOR AN AIRCRAFT**

(57) A fairing (2) for an aircraft is disclosed in which the fairing (2) comprises a first fairing portion (10) configured to be fixedly attached to a first structural component (4) and having a first edge (19); a second fairing portion (11) configured to be fixedly attached to a second structural component (5) and having a second edge (20), wherein the first edge (19) and the second edge (20) define an interface (12) configured to enable relative movement between the first fairing portion (10) and the second fairing portion (11).

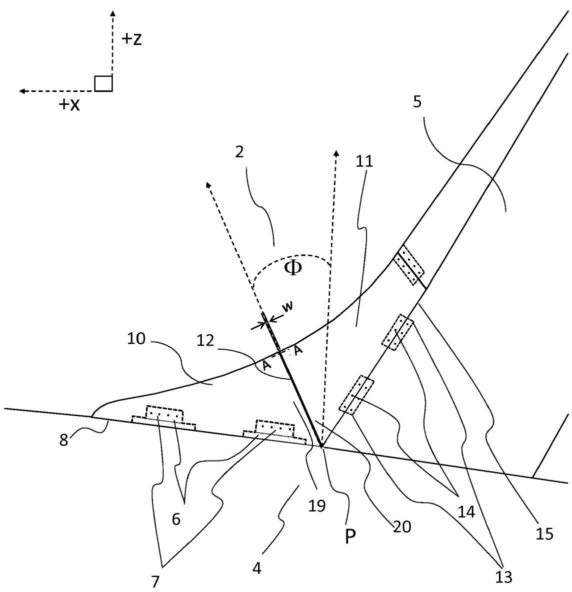

FIG 2

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Description

BACKGROUND OF THE INVENTION

[0001] The present technology relates to a fairing for an aircraft.

[0002] A fairing is a structure typically used for aircraft to covers gaps or spaces between structural components of an aircraft, for example between regions of the fuselage and the wing and/or the vertical and horizontal tail. Their primary purpose is to provide a smooth aerodynamic surface over the gaps and spaces that would otherwise occur in these regions, so that the airflow in the region is altered in a way to reduce overall aerodynamic drag.

[0003] They are typically formed as single unitary components of composite material construction that are attached to surrounding structural components with attachment assemblies.

[0004] The attachment assemblies typically comprise any combination of buttstraps, L or T shaped profiles, and support frames that are fastened together using mechanical fasteners to the surrounding structural components.

[0005] The mechanical design of a fairing and its attachment assemblies must take into account load cases that are estimated by the designer. Some estimated loads cases are important to the main function of the fairing itself i.e. providing a structurally rigid and smooth airflow surface for the loads to be expected during operation of the aircraft. Other load cases are what are termed as 'critical' because they determine the structural integrity of the overall design, which must be sufficient to withstand these critical load cases without any unacceptable failure occurring. Being able to demonstrate that a given fairing design structurally survives such critical load cases is essential to certification of the design and of the aircraft.

[0006] The critical loads cases for a fairing normally take place when the design comprises a single unitary fairing body that is fixedly attached by attachment assemblies between a first structural component, for example the fuselage, and a second structural component, for example the vertical tail, and when relative displacement between the structural components are at a maximum and/or minimum. These types of loads can be relatively high and are typically referred to as induced loads due to fact that the fairing body and its attachment assemblies form a load path between the structural components. In these critical loads cases, the unitary fairing body and it's attachment assemblies must have sufficient strength and stiffness to cope with instances of high induced loads, for example: tensile, compression, bending, torsion or bypass loads. The critical load cases may dominate the overall design of a unitary fairing body and its attachment assemblies. Designing a fairing according to the above described design philosophy typically leads to a fairing with large part thicknesses, high part counts and the use of high performance material such as titanium or steel fasteners in combination with the use of a unitary carbon fibre composite sandwich fairing component. Ultimately, this leads to a conservative design that overall is heavy, as well as complex and expensive to design and manufacture.

SUMMARY OF THE INVENTION

[0007] An embodiment of the present technology provides a fairing 2 for an aircraft, wherein the fairing 2 comprises a first fairing portion 10 configured to be fixedly attached to a first structural component 4 and having a first edge 19; a second fairing portion 11 configured to be fixedly attached to a second structural component 5 and having a second edge 20 , wherein the first edge 19 and the second edge 20 define an interface 12 configured to enable relative movement between the first fairing portion 10 and the second fairing portion 11.

[0008] The interface 12 is configured to prevent loads being transferred through the fairing 2 due to relative movement between the first structural component 4 and second structural component 5. Such an interface 12 allows for a fairing 2 wherein the overall design of the fairing 2 is not governed by critical loads cases relating to the maximum and minimum relative displacement of the first and second structural components 4 and 5, but is rather instead governed by only aerodynamic loading of the fairing 2.

[0009] As the fairing 2 and its corresponding attachment assembly 9 and 18 are designed to a lower load level compared to other solutions, the resulting design will have a reduced component part count and weight due to less profiles, buttstraps and mechanical fasteners. It also results in a lower cost to manufacture due to the use of less exotic materials that have a lower mechanical performance requirement.

[0010] In a further embodiment, the interface 12 is provided with at least one seal 21. A function of the seal 21 is to prevent fluid such as water, contaminants such a hydraulic fluid or debris such as dust, insects, or ash, from transitioning through the interface to the interior the fairing 2.

[0011] The seal 21 can also provide a smooth uninterrupted exterior surface of the fairing 2 between the first and second fairing portions 10 and 11, so as to prevent any unwanted aerodynamic flow separation or aeroacoustic phenomena.

[0012] The seal 21 may be formed of a resilient material which ensures that deflection loads are not transferred from the first fairing portion 10 to the second fairing portion 11 and vice versa through the seal. The seal (21) may further comprise a deformable cavity (27). The seal (21) may be formed from a resilient material that is reinforced.

[0013] In a further embodiment the seal 21 is provided by a resilient sealing material that is applied to the interface 12 before or after final assembly of the fairing 2 to the aircraft's first and/or second structural components 4 and 5.

[0014] In another embodiment, the seal 21 is provided by at least one ply of resilient material that is an outer, inner or intermediate ply attached to the first fairing portion 10 and the second fairing portion 11.

[0015] Having an interface 12 further provided with at least one seal 21 formed using a ply of resilient material may be preferable when a seal design that is less prone to edge erosion is required. Furthermore, such an arrangement may also provide an interface 12 where less deformation of the seal 21 occurs during operation, which will result in an even smoother aerodynamic surface between the first and second fairing portions 10 and 11.

[0016] In a further embodiment the fairing 2 may comprise an interface 12 that is an overlapping type of interface 12 defined by overlapping corresponding edges 19 and 20 of the first fairing portion 10 and second fairing portion 11 when they are fixedly attached to the first structural component 4 and second structural component 5, respectively. Such an interface 12 may provide an improved structural arrangement such that aerodynamic pressure loads acting normal to the surface of the fairing 2 may be distributed more evenly between the first and second portions of the fairing 10 and 11, whilst still ensuring that induced loads due to relative movement between the first and second structural components 4 and 5 are minimised or avoided entirely.

[0017] In another embodiment the interface 12 that is defined by overlapping corresponding edges 19 and 20 further comprises at least one seal 21, configured to further prevent contaminant ingress transitioning through the interface 12.

[0018] Such an interface 12 may in addition or alternatively be provided with a friction reducing coating 25 and/or part 26 configured to reduce friction between the edge 19 of the first fairing portion 10 and the corresponding edge 20 of the second fairing portion 11 when the aerodynamic fairing 2 is in use. This may reduce mechanical wear of the fairing 2 during its service life, therefore reducing the need for removal of the fairing 2 from the aircraft 1 for maintenance or repair.

[0019] In a further embodiment the friction reducing coating 25 is provided by a Teflon coating applied to the overlapping surfaces 23 and 24 of the first fairing portion 10 and the second fairing portion 11.

[0020] In another embodiment, the fairing 2 comprises an interface 12 with a maximum overlap dimension L that varies along the length of the interface 12 so as to take into account differences of expected displacement when the aerodynamic fairing 2 is in use. Defining an interface 12 in such a way may provide optimum dimensions of the interface 12 during critical loads cases where the magnitudes of the interface gap dimensions are expected to be at a minimum and at a maximum. At a minimum interface gap dimension, it is preferred that the edges 19 and 20 of the first and second fairing portions 10 and 11 do not contact one another so as to cause structural damage and transfer of displacement induced loads through the interface 12. At cruise conditions, it may be preferable that the interface gap dimensions are continuous along the length of the interface 12. At a maximum interface gap dimension, it may be preferable to ensure that that edges 19 and 20 of the first and second fairing portions 10 and 11 maintain an overlap along the length of the interface 12, so as to maintain even distribution of aerodynamic pressure loads between the first and second fairing portions 10 and 11, and or to maintain a seal 21 arrangement substantially between the exterior and interior of the fairing 2 and/or to maintain aerodynamic and aero-acoustic performance of the fairing 2 by providing a smooth aerodynamic surface between the first and second fairing portions 10 and 11.

[0021] The first structural component 4 may be a fuselage of an aircraft 1. The second structural component 5 may be the vertical tail of an aircraft 1. Displacement between the vertical tail and the fuselage in critical load cases are typically of a magnitude well suited to the application of an aerodynamic fairing 2 designed according to any embodiment described.

[0022] However it will be appreciated by the skilled person that either component may comprise any other suitable arrangement of structural components located adjacent to one another where induced load transfer would need to be avoided. For example, aerodynamic fairings so far described may also preferably be used where the first structural component 4 is a fuselage of the aircraft and the second structural component 5 is a wing of an aircraft. Displacement between the wing and the fuselage in critical load cases are also typically of a magnitude well suited to the application of an aerodynamic fairing 2 designed according to any embodiment described. Further benefits and advantages of the present invention will become apparent from the detailed description with appropriate reference to the accompanying drawings.

DETAILED DESCRIPTION

[0023]

Figure 1 shows a left hand side view of an aircraft 1 comprising a type of fairing 2 according to a first embodiment of the present invention. The aircraft 1 is shown in flight in steady and level flight. i.e. during cruise phase of flight. Figure 1 also provides a set of orthogonal axes which represent the aircraft longitudinal axis (X) and vertical axis (Z). The orthogonal aircraft lateral axis or spanwise axis (Y) is shown in more detail in figure 3.

Figure 2 shows a close-up left hand side view of the fairing 2 and surrounding structure of figure 1 also with hidden detail that shows the attachment assemblies used to attached the fairing 2 to the surrounding structural components 4 and 5.

Figure 3 shows a plan view of the fairing 2 of figure 2, again with the same hidden detail. It is shown also that the fairing 2 is symmetrical through a local fairing vertical plane lying on the aircraft X-Z plane.

[0024] From figure 2 and 3, it is shown that the main body of the fairing 2 is composed of two substantially separate portions; a first portion 10 positioned forward of (i.e. positive X direction), and in close proximity to, a second portion 11. Both the first and second portions 10 and 11 are positioned between a leading edge junction region of a first structural component 4 that in this present embodiment is the upper surface region of the aft fuselage and a second structural component 5 that in this present embodiment is lower leading edge region of the vertical tail of the aircraft 1.

[0025] The first fairing portion 10 is fixedly attached to the fuselage 4 via a first set of L shaped aluminium profiles 6 and corresponding rows of mechanical fasteners 7. The profiles 6 are fixedly attached to both the outer skin of fuselage 4 in four positions and to corresponding four positions on the first fairing portion 10 adjacent to it's lower peripheral edge 8. The profiles 6 and corresponding mechanical fasteners are considered to be the first attachment assembly 9.

[0026] Similarly, the second fairing portion 11 is fixedly attached to the vertical tail 5 via a set of five buttstraps 13 and corresponding rows of mechanical fasteners 14. Four out of five buttstraps are fixedly attached to both the leading edge of the vertical tail 5 in four positions and to four corresponding positions along the peripheral trailing edge 15 of the second fairing portion 11. A further fifth curved buttstrap 13 is fixedly attached to both a lower leading edge element 16 of the vertical tail and the upper peripheral edge 17 of the second fairing portion 11. The buttstrap 13 and corresponding mechanical fasteners 14 are considered to be a second attachment assembly 18.

[0027] An interface 12 is formed between an aft peripheral edge 19 of the first fairing portion 10 that is set apart from a foremost peripheral edge 20 of the second fairing portion 11, which are opposite to one another when the first fairing portion 10 and second fairing portion 11 are installed on the aircraft 1 In the cruise condition of figures 1 to 3, the interface 12 comprises a gap of dimension w defined between the edges 19 and 20 of the first and second fairing portions 10 and 11 respectively.

[0028] The first and second fairing portions 10 and 11 are both formed as lightweight composite sandwich components, each incorporating a cured layup of non-metallic, lightweight structural NOMEX Honeycomb core, in combination with GFRP prepreg laminate plies (not shown). The plies are a balanced layup of woven prepreg laminate plies which are cured as an assembly in an autoclave. The first and second fairing portions 10, 11 are manufactured as separate components. The honeycomb core does not extend in the layup to the peripheral edges 8, 19, 20, 15, 17, of each portion 10 and 11 i.e. the edges 19 and 20 are formed of monolithic layups of GFRP plies.

[0029] Alternatively, unidirectional prepreg or dry fibres may be used in the design. CFRP prepreg or any other suitable combination of material may be used for the laminate plies. Furthermore, a foam core such as ROHACELL® foam core may be used as an alternative to the honeycomb core or any other suitable stiffening means may be used such as integrally or separately attached stringers formed of composite or metallic material.

[0030] The first and second fairing portions 10 and 11 may alternatively be substantially formed of a metallic alloy such as aluminium alloy. The portions 10 and 11 may be manufactured from sheet material using and suitable operation such as superplastic forming, shot-peen forming or alternatively formed using casting, additive layer manufacture or by milling from a single forged billet.

[0031] From figure 2 and figure 3, it should be understood that the leading edge region and fuselage are highly curved so the fairing 2 and thus the interface 12 takes the form of a complex 3D curve, which, in figure 2 is represented by a straight 2D curve where the 3D curve is shown projected onto an X-Z plane defined by orthogonal aircraft axes X and Z. From figure 2, it is shown that the interface 12 bifurcates the fairing 2 into a first portion 10 and second portion 11 at an angle Φ equal to approximately 20 degrees from the Z vertical. The interface 12 starts and ends at points P and Q, respectively as shown in figure 3.

[0032] It should be appreciated that parameters such as the sweep, leading edge curvature and thickness of the vertical tail 5, diameter of the fuselage section 4 may affect the optimal position of the interface 12, which may be represented by any curve at any angle Φ starting at any position along the lower peripheral edges 15 and 8 of the fairing, however it is preferred that the curve defines the fairing 2 into two approximately equally sized portions 10 and 11 capable of providing an aerodynamic and structural benefits so far described.

[0033] Figure 4 shows a further close-up left hand side view of the same aircraft 1 of figure 1, 2 and 3, except each that the aircraft 1 in this instance undergoes a first critical load case whereby the fuselage 4 and vertical tail 5 are subject to a bending moment M' in the X-Z plane, such that both structural components are deflected away from each other to a maximum permissible amount. The first fairing portion 10 and second fairing portion 11 are as a result displaced away from each other in the direction indicated by the opposing arrows such that the interface 12 has gap dimension *w'*, which is greater than the dimension w, present in the cruise condition of figure 2 to 3.

[0034] Figure 5 shows a yet a further close-up left hand side view of the same aircraft 1 of figure 1, 2 and 3, except each that the aircraft 1 in this scenario experiences a second critical load case whereby the fuselage 4 and vertical tail 5 are subject to a bending moment M", in the X-Z plane, such that both are displaced towards each other to a maximum permissible amount. The first fairing portion 10 and second fairing portion 11 are displaced towards each other in the direction indicated by the opposing arrows such that the interface 12 has a gap dimension w", which is less than the gap dimension w, present in the cruise condition of figure 2 to 3.

[0035] Figure 6 provides three cross-sections taken normal at the locations shown through the surface of the fairing 2 at different load cases i.e. the fairings shown in figures 2 to 5. Section A-A of figure 6 represents a cross-section of the interface 12 during the cruise phase of flight wherein the interface 12 comprises a substantially continuous gap dimension *w* defined between the edges 19 and 20 along their length of the first and second fairing portions 10 and 11 respectively. Preferably w should be no greater than 6mm in cruise.

[0036] Section A'-A' of figure 6 represents a cross-section of the interface 12 during the first critical load case of figure 4 whereby the first fairing portion 10 and second fairing portion 11 are displaced away from each other by a maximum amount and wherein the interface 12 comprises a gap dimension w' in the same manner of the preceding paragraph. Preferably w' should be no greater than 10mm during the first critical load case.

[0037] Similarly, section A"-A" represents a cross-section of the interface 12 during a second critical load case of figure 5 whereby the first fairing portion 10 and second fairing portion 11 are displaced towards each other by a maximum amount and wherein the interface 12 comprises a gap dimension w" in the same manner of the preceding paragraph. Preferably w" should be no greater than 2mm during the second critical load case.

[0038] Figure 7 shows a further embodiment to the one shown in figures 1 to 6, wherein the interface 12 is provided with a seal 21. The seal 21 is formed of a formed by a resilient two part curable sealing material such as 3M™ Aerospace Sealant AC-250 that is sufficiently elastic so as to ensure that no significant load is transferred from the first fairing portion 10 to the second fairing portion 11, or vice versa, due to relative movement of the first structural component 4 and second structural component 5 when the fairing 2 is in use. The seal 21 is applied and formed to the interface 12 before attachment of the first fairing portion 10 and second fairing portion 11 to the aircraft's fuselage 4 and vertical tail 5. This may be achieved by temporarily attaching the first portion 10 and second portion 11 to a jig that holds the portions 10 and 11 relative to each other in the expected cruise position and then applying the curable sealant. It may alternatively be applied when the fairing portions 10 and 11 are fixedly attached to the fuselage 4 and vertical tail 5 of the aircraft. The interface 12 may be provided with a seal 21 that is substantially continuous along the length of the interface 12, or it may be provided with multiple seals 21.

[0039] Figure 8 provides an alternative embodiment of a seal 21 of predetermined dimensions formed from a fabric reinforced resilient material. The seal 21, is bonded using an aerospace grade adhesive to the upper surface of the first and second fairing portions 10 11 and it covers the interface 12. The seal 21 also extends around the edge 19 to the lower surface of the first fairing portion 10 and is bonded to the lower surface also. This ensures that the if the bond to the upper surface of the first fairing portion 10 fails, there will be sufficient bond remaining on the lower surface to ensure that the seal 21 does not come away from the fairing 2 due to aerodynamic forces acting on the seal 21 in flight. Such a seal may also be installed by any other means such as by fastening to the edges 19 and 20 of the first and second fairing portions 10, 11 before or after the interface 12 is formed. The seal 21 may alternatively only be bonded to the first fairing portion 10.

[0040] Figure 9 provides yet another embodiment of a seal 21 of predetermined dimensions formed from a fabric reinforced resilient material. The seal 21 further comprises a deformable cavity 27 and two leg portions 28 and 29 which are bonded the upper and lower surfaces of only the first fairing portion 10 using an aerospace grade adhesive. A seal 21 with deformable cavity 27 may be preferable where the magnitudes of deflection between the first and second portions 10 and 11 are substantial. The upper surface of the first fairing portion 10 comprises a recess 30 to which the first leg portion 28 is bonded. Such an arrangement is further advantageous in that a seal 21 need only be applied to a single fairing portion, which will lead to simplification of design and increased ease of maintenance and repairability. It should be appreciated that the seal 21 may only comprise one of the legs and therefore be substantially P-shaped. Furthermore such a seal may be installed by any other means such as by fastening to the edge 19 of the first fairing portion 10 before or after the interface 12 is formed.

[0041] The respective types of seal 21 of figures 7, 8 and 9 resiliently deform accordingly to gap dimensions w, *w'* and *w"*. It should be noted that whilst the seal 21 in each case deforms resiliently for all ranges of deflection between the first and second fairing portions 10 and 11, they retain their integrity and should not rupture. Furthermore, it should be noted that they are configured to provide an optimal aerodynamic profile in cruise where the gap dimension is *w*.

[0042] Figure 10 shows yet a further embodiment of the present invention. A close-up left hand side view of the same aircraft 1 of figure 1 is shown in flight in steady and level flight. i.e. during cruise phase of flight.

[0043] In the embodiment of figure 10, the first and second portions 10 and 11 are formed substantially the same as that of previous embodiments, however the seal 21 is instead provided by at least one ply of resilient material that is an intermediate ply in the layup of the monolithic plies of GFRP of both the first and section fairing portion edges 19 and 20. Alternatively, the ply may be an outermost or innermost ply of the first and second body portions, adjacent to the interface 12. The ply of resilient material may be co-bonded, secondary bonded, co-cured or adhered or any other suitable means. The resilient material in this example is an isotropic aviation grade rubber. It may also be formed substantially from aviation grade silicone, which is particularly useful for higher temperature applications. Additionally, the resilient material may be reinforced with glass fibres. Other reinforcing materials may also be used for example, polyester woven fabrics and or meshes. The reinforcement may be added to provide a reinforced resilient material that has quasi-isotropic mechanical properties.

[0044] Having an interface 12 further provided with seal 21 that is integral with both the first and second fairing portion 10 and 11 may be preferable if a design subject to less edge erosion is required. Furthermore, such an arrangement may also provide an interface 12 where less deformation of the seal 21 occurs during operation, which will result in an even smoother aerodynamic surface between the first and second fairing portions 10 and 11.

[0045] Figure 11 shows a further close-up left hand side view of the same aircraft 1 of figure 10, except that the aircraft 1 in this instance undergoes a first critical load case whereby the fuselage 4 and vertical tail 5 are subject to a bending moment M' such that both are deflected away from each other to a maximum permissible amount. The first fairing portion 10 and second fairing portion 11 are displaced away from each other in the direction indicated by the opposing arrows such that the interface 12 has a gap dimension *w'*, which is greater than the gap dimension w, present in the cruise condition of figure 10.

[0046] Figure 12 shows a yet a further close-up left hand side view of the same aircraft 1 of figure 10, except each that the aircraft 1 in this scenario experiences a second critical load case whereby the fuselage 4 and vertical tail 5 are subject to a bending moment M" such that both are displaced towards each other to a maximum permissible amount. The first fairing portion 10 and second fairing portion 11 are displaced towards each other in the direction indicated by the opposing arrows such that the interface 12 has a gap dimension w", which is less than the gap dimension w, present in the cruise condition of figure 10 and 11.

[0047] Figure 13 provides three cross-sections taken at the locations and directions shown in figures 10 to 12 through the surface of the fairing 2 at different load cases. Therefore section G-G of figure 13 represents a cross-section of the interface 12 of figure 10 during the cruise phase of flight wherein the interface 12 comprises seal 21 formed at least one ply of integrally cured resilient material. A substantially continuous gap dimension w is defined between the edges 19 and 20 along their length of the first and second fairing portions 10 and 11 respectively. Preferably w should be no greater than 6 mm during the second critical load case.

[0048] Section G'-G' of figure 13 represents a cross-section of the interface 12 during the first critical load case of figure 11 whereby the first fairing portion 10 and second fairing portion 11 are displaced away from each other by a maximum amount. The interface 12 comprises a gap dimension w' in the same manner of the preceding paragraph. Preferably w' should be no greater than 10 mm during the first critical load case.

[0049] Similarly, section G"-G" represents a cross-section of the same interface 12 during a second critical load case of figure 12 whereby the first fairing portion 10 and second fairing portion 11 are displaced towards each other by a maximum amount. The interface 12 comprises a gap dimension w" in the same manner of the preceding paragraph. Preferably w" should be no greater than 2mm during the second critical load case.

[0050] In yet another alternative embodiment of the invention previously shown in figures 1 to 5 is provided in figure 14. In this alternative embodiment, the opposing edges 19 and 20 of the first fairing portion 10 and second fairing portion 11 form an overlap when installed on the aircraft such that overlapping surfaces 23 and 24 are defined by the first fairing portion 10 and second fairing portion 11, respectively. The gap dimensions w, w' and w" are provided in substantially same way as the embodiments previously described in figures 1 to 5. A maximum overlap length L is shown in section A"-A", which is a constant value in the embodiment shown.

[0051] In the present embodiment, a friction reducing coating 25 provided by a Teflon coating applied to the upper overlapping surface 23. The purpose of the friction reducing coating 25 is to alleviate any residual friction forces that may occur between the edge 19 of the first fairing portion 10 and the corresponding edge 20 of the second fairing portion 11 when the fairing 2 is in use. The friction reducing coating 25 may be provided by any other suitable material for example a polyamide material. In addition or alternatively the seal 21 may be provided with a friction reducing part 26. The part may include at least one corrosion/wear resistant and suitably smooth pad affixed to either or both of the overlapping surfaces 23 and 24 of the first and second fairing portions 10 and 11. This part may be formed of stainless steel or nylon and may in addition be coated in Teflon or any other suitable friction reducing coating 25.

[0052] Figure 15 provides yet another embodiment that is substantially in accordance with the previous embodiment of figure 14. In this further embodiment, the interface 12 that is defined by overlapping corresponding edges 19 and 20 of figure 12 and further comprises a seal 21. The seal 21 is formed by a resilient two part curable sealing material such as 3M™ Aerospace Sealant AC-250 that is applied to the interface 12 before attachment of the first fairing portion 10 and second fairing portion 11 to the aircraft's fuselage 4 and vertical tail 5. Such an arrangement may provide the only or otherwise additional means to prevent contaminant ingress transitioning through the interface 12. Alternatively a seal 21 of predetermined dimensions may be substantially formed using a resilient material such reinforced or unreinforced rubber or silicone, which can then be installed by bonding or by fastening to the first and second fairing portions 10 and 11 before or after the interface 12, is formed.

[0053] Figures 16 to 20 describe yet a further embodiment of the invention. In certain circumstances the 3D shape of the fairing 2 may be highly curved (and therefore the curve of the interface 12 also). The magnitude of relative deflection of the first structural component and second structural component (and hence the movement between the edges 19 and 20) may also depend on the distance of the interface 12 from the points P or Q as shown in figure 17. In these circumstances, an overlapping interface needs to be carefully designed. In this further embodiment, the overlapping corresponding edges 19 and 20 of figure 12, which define the interface 12 dimensions, have themselves dimensions which vary along the interface length.

[0054] Figures 16 and 17 show a close-up left hand side view of the fairing 2 that is substantially in accordance with the previous embodiments of figures 1 to 5 and figures 14. In both figures 16 and 17, the aircraft 1 is in flight in steady and level flight. i.e. during cruise phase of flight. Three section views D-D, E-E and F-F through the interface 12 are provided which correspond to the fairing 2 in the cruise flight condition. The position of section view D-D is the furthest position (mid-length) on the interface 12 from the starting and ending points P and Q.

[0055] Figure 18 shows a further close-up left hand side view of the fairing 2 of figure 16, except that the aircraft 1 in this instance undergoes the first critical load case whereby the fuselage 4 and vertical tail 5 are subject to a bending moment M' such that both structural components are deflected away from each other by a maximum permissible amount. Three section views D'-D', E'-E' and F'-F' through the interface 12 are shown. Section D'-D' of figure 18 is at the same position and orientation along the interface 12 from point P as section D-D of figures 16 and 17, with the only difference being that section D'-D' provides a cross section at when the aircraft experiences the first critical load case. A maximum gap dimension wd' results and is shown for this critical load case in Figure 20. Similarly E'-E' and F'-F' correspond to the same positions and orientations of sections E-E and F-F, and the maximum gap dimensions we' and *wf'* correspond to the each of these sections (and the associated critical load cases), respectively.

[0056] Figure 19 shows another close-up left hand side view of the fairing 2 of figure 16, except that the aircraft 1 in this instance undergoes the second critical load case whereby the fuselage 4 and vertical tail 5 are subject to a bending moment M" such that both structural components are deflected towards each other to a maximum permissible amount. Three section views D"-D", E"-E" and F"-F" through the interface 12 are also shown. Section D"-D" of figure 19 is at the same position and orientation along the moveable interface 12 from point P as section D-D of figures 16 and 17 and hence also section D'-D' of figure 18, with the only difference being that section D"-D" provides a cross section when the aircraft experiences the second critical load case. Similarly E"-E" and F"-F" correspond to the same positions and orientations of sections E-E and F-F, respectively.

[0057] Figure 20 shows a compilation of all of the section views indicated in figures 16 to 19 i.e. a section view at each designated position for the cruise, first critical load case and second load case conditions.

[0058] As can be seen in the present embodiment, the design of the maximum overlap dimension (previously shown with reference item L in figure 14) is not constant along the length of the interface 12. For sections D"-D", E"-E", and F"-F", the respective maximum overlap dimensions LD, LE and LF differ. In combination with figure 18, the configuration is such that the relative displacement of the interface 12 is at a maximum at the position of section D' - D', that is, at the position on the interface 12 which is the furthest distance from point P and Q. The maximum dimension of the overlap is decreased monotonically from the position of D'- D' towards point P and point Q such that LD>LE>LF and *wd'>we'>wf'*. In the present example, there is no overlap remaining at point P and Q, however the point of termination of the overlap can be chosen as desired according to the design.

[0059] From figure 20, it should be appreciated that the overlap dimension of the interface 12 along its length is further arranged such that dimensions *w* and *w*" of the interface 12 are the same for each section position in cruise and for the second critical load case condition.

[0060] This ensures that for the cruise condition the aerodynamic drag caused by the dimension *w* of the interface 12 is minimised consistently along the length of the interface 12. Furthermore, it ensures that for the second critical load case condition, a minimum interface 12 dimension w" is maintained, such that damage that would otherwise occur due to the edge portions 19 and 20 of the first and second fairing portions 10 and 11 contacting one another at any point along the length of the interface 12, is avoided.

[0061] Defining an interface 12 in the way described in the present embodiment provides optimum dimensions of the interface 12 during critical loads cases where the magnitudes of the interface dimensions are expected to be at a minimum and at a maximum. Where in the foregoing description, integers or elements are mentioned which have known, obvious or foreseeable equivalents, then such equivalents are herein incorporated as if individually set forth. Reference should be made to the claims for determining the true scope of the present invention, which should be construed so as to encompass any such equivalents. It will also be appreciated by the reader that integers or features of the invention that are described as preferable, advantageous, convenient or the like are optional and do not limit the scope of the independent claims. Moreover, it is to be understood that such optional integers or features, whilst of possible benefit in some embodiments of the invention, may not be desirable, and may therefore be absent, in other embodiments.

Claims

1. A fairing (2) for an aircraft, the fairing (2) comprising:

   a first fairing portion (10) configured to be fixedly attached to a first structural component (4) and having a first edge (19);
   a second fairing portion (11) configured to be fixedly attached to a second structural component (5) and having a second edge (20), wherein the first edge (19) and the second edge (20) define an interface (12) configured to enable relative movement between the first fairing portion (10) and the second fairing portion (11).

2. The fairing (2) of claim 1, wherein the interface (12) is configured to prevent loads being transferred through the fairing due to relative movement between the first structural component (4) and second structural component (5).

3. The fairing (2) of claim 1 or 2, wherein the interface (12) is further provided with one or more seals (21).

4. The fairing (2) of claim 3, wherein the seal (21) is formed from a resilient material.

5. The fairing (2) of claim 4, wherein the seal (21) further comprises a deformable cavity (27).

6. A fairing (2) according to either claim 4 or 5, wherein the seal (21) is formed from resilient material that is reinforced.

7. The fairing (2) of either claim 3 or 6, wherein the seal (21) is formed from at least one ply of resilient material configured to be an outer, inner or intermediate ply attached to the first fairing portion (10) and the second fairing portion (11).

8. A fairing (2) according to any of the claims 1 to 3, wherein the interface (12) is defined by overlapping opposing edges (19, 20) of the first fairing portion (11) and second fairing portion (12).

9. A fairing (2) according to claim 8, wherein the overlapping interface (12) further comprises a friction reducing coating (25).

10. A fairing (2) according to claim 9, wherein the friction reducing coating (25) is substantially formed from Teflon applied to an overlapping surface (23) of the first fairing portion (10) or an overlapping surface (24) of the second fairing portion (11).

11. A fairing (2) according to any claims 8 to 10, wherein the interface (12) is further provided with at least one seal (21).

12. A fairing (2) according to any claims 8 to 11, wherein the maximum overlap dimension varies along the length of the interface (12) so as to take into account differences of expected displacement when the fairing (2) is in use.

13. A fairing (2) according to claim 12, wherein the maximum overlap dimension varies monotonically along the length of the interface (12).

14. A fairing (2) according to any preceding claim, wherein the first structural component (4) is a fuselage of the aircraft and the second structural component (5) is a vertical tail of an aircraft.

15. An aircraft (1) comprising a fairing (2) according to any preceding claim.

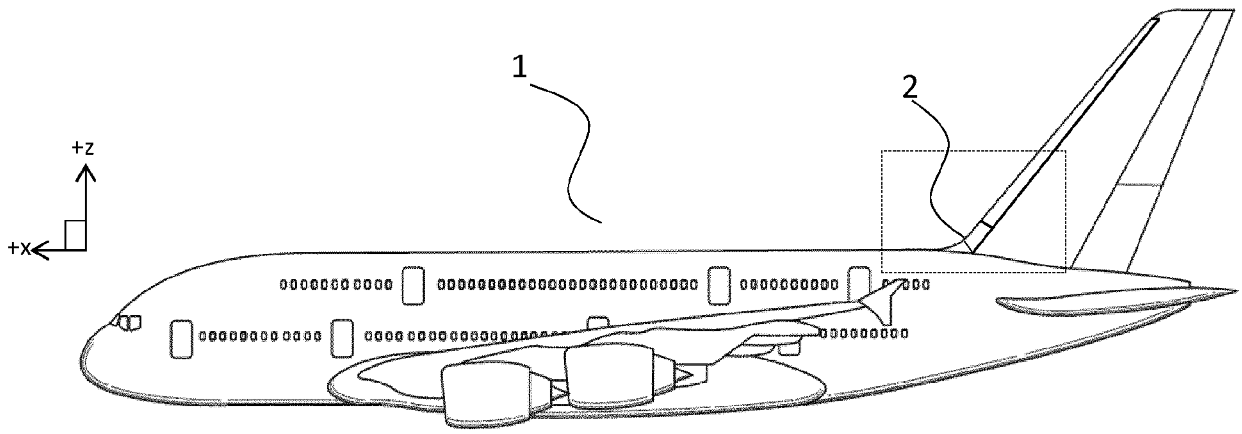


FIG 1

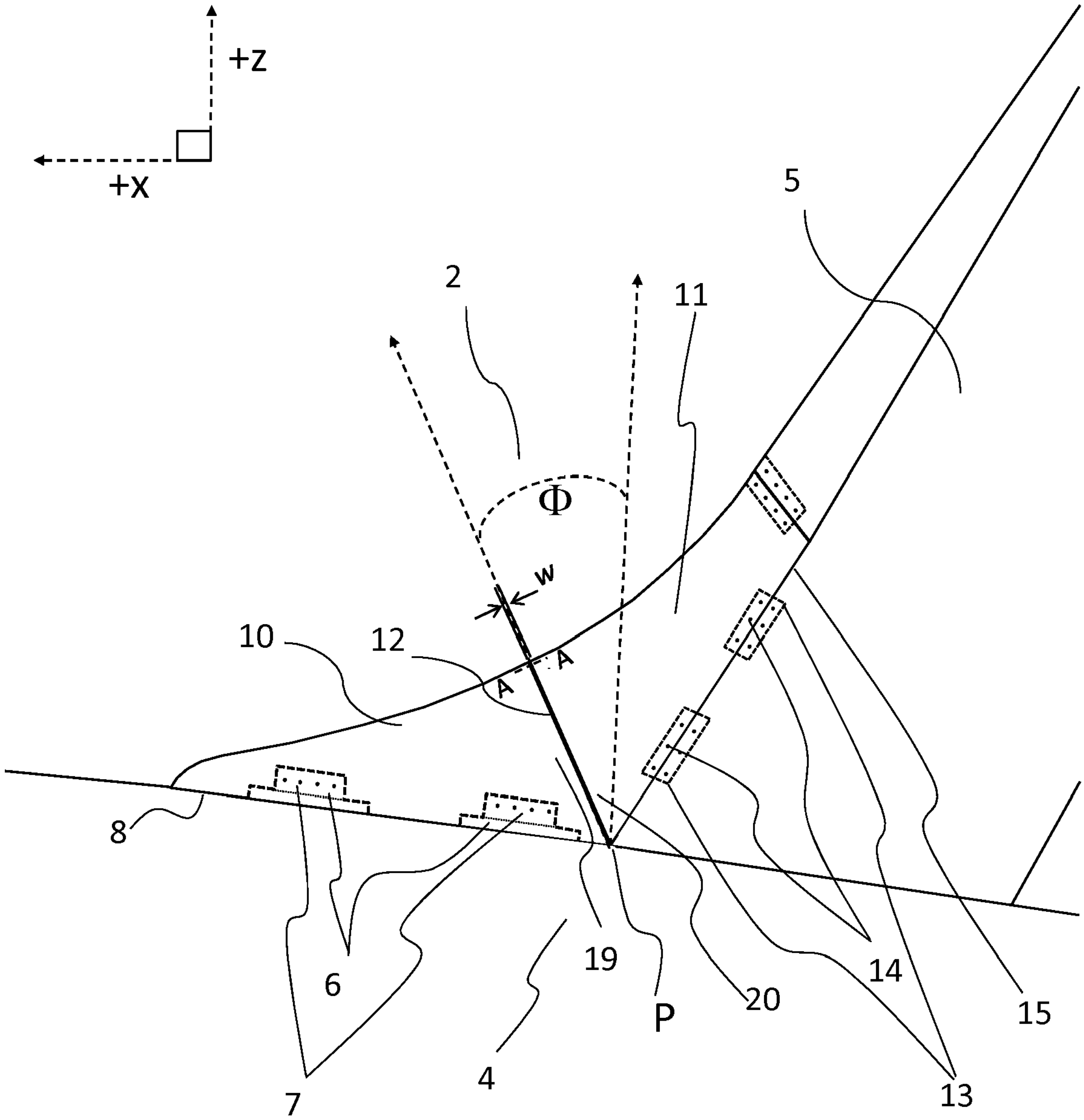


FIG 2

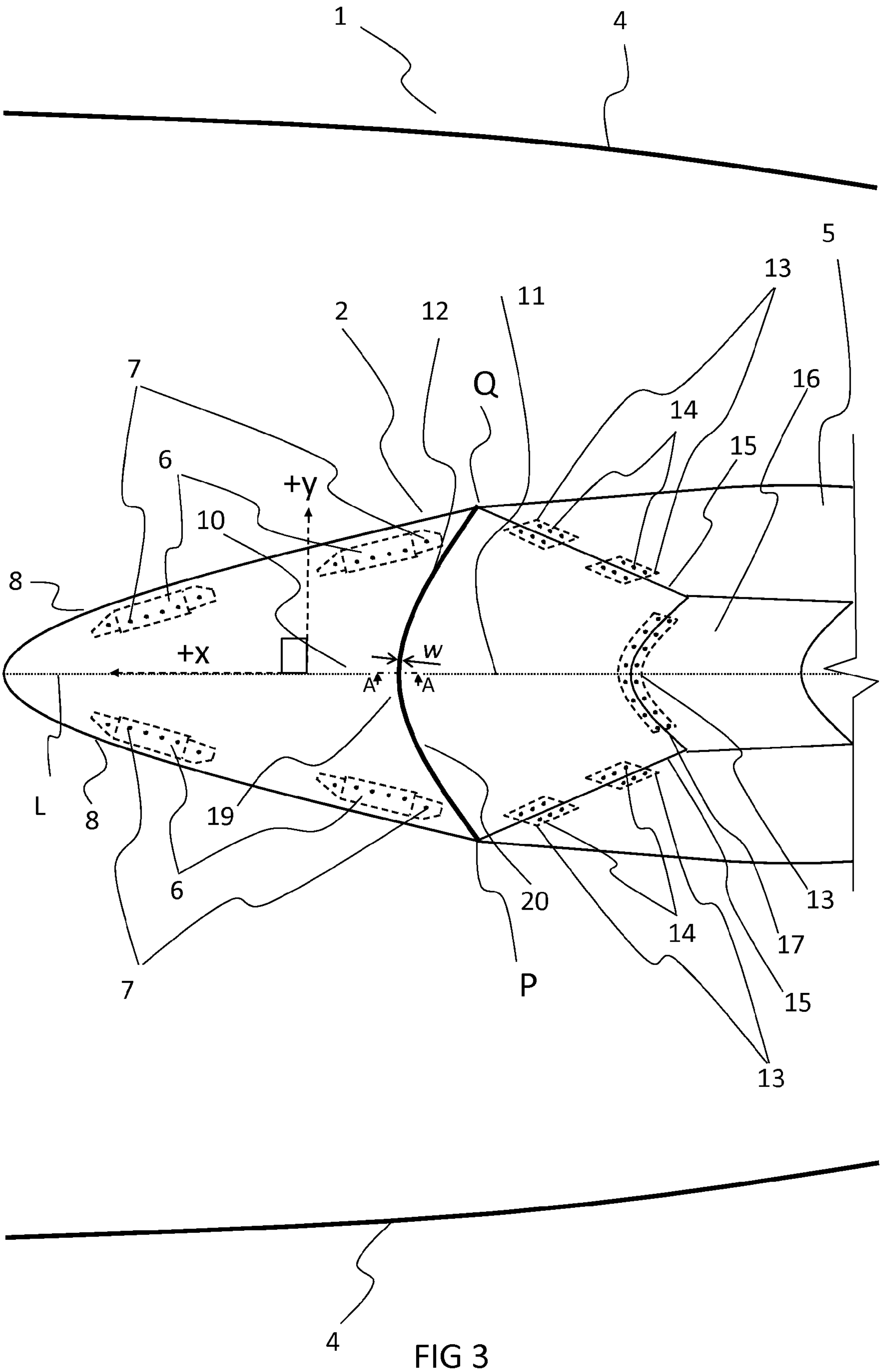


FIG 3

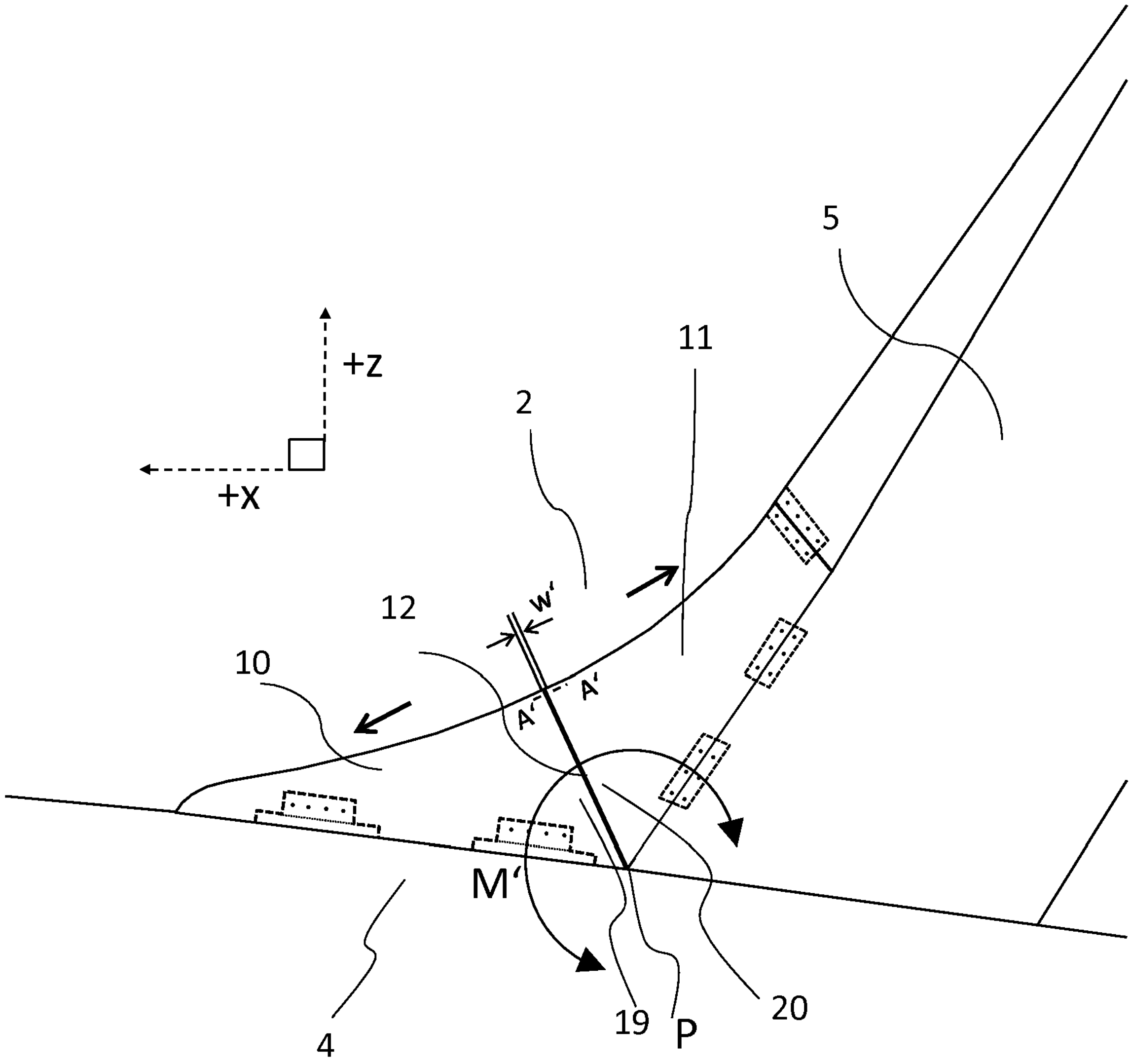


FIG 4

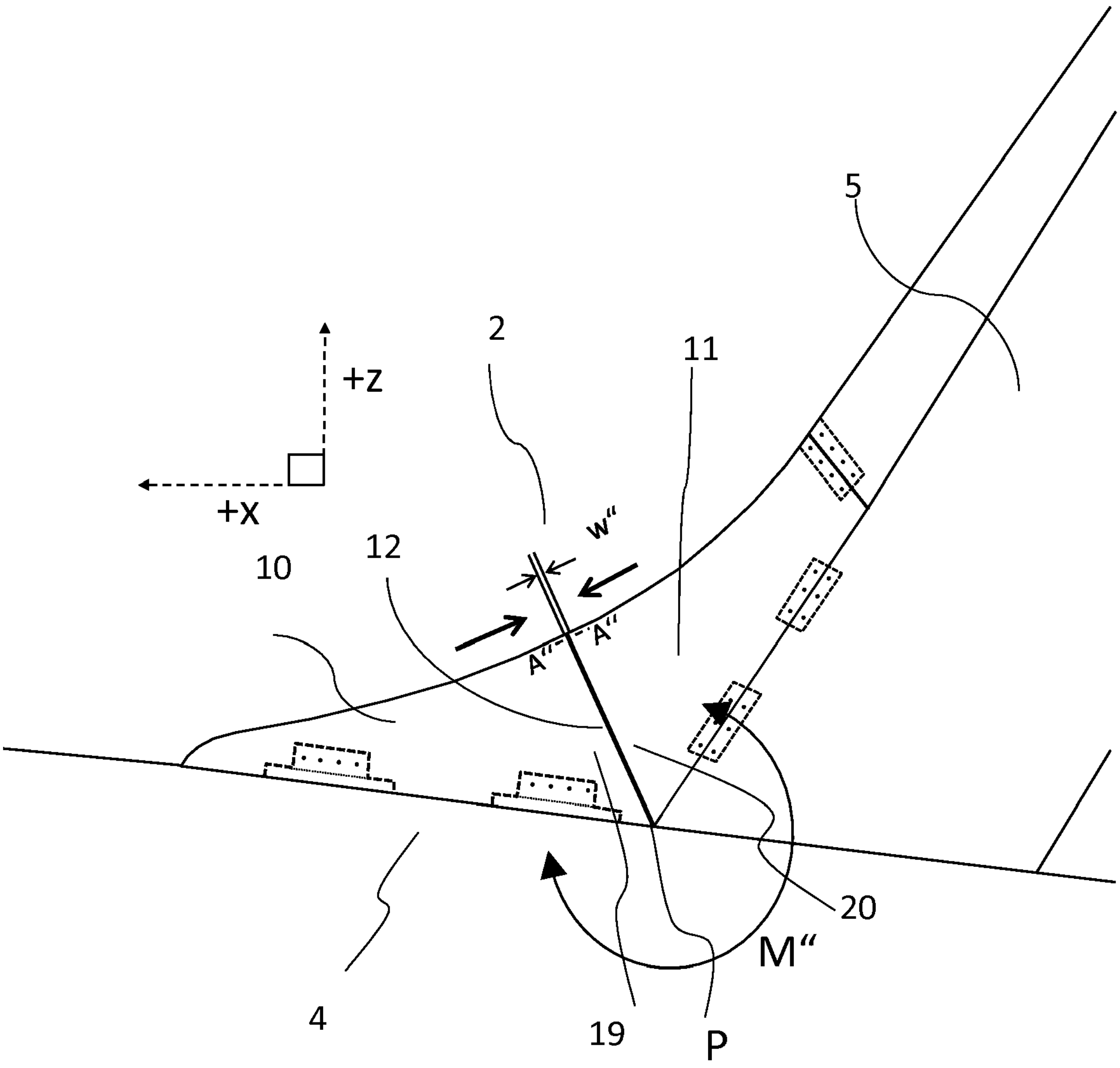


FIG 5

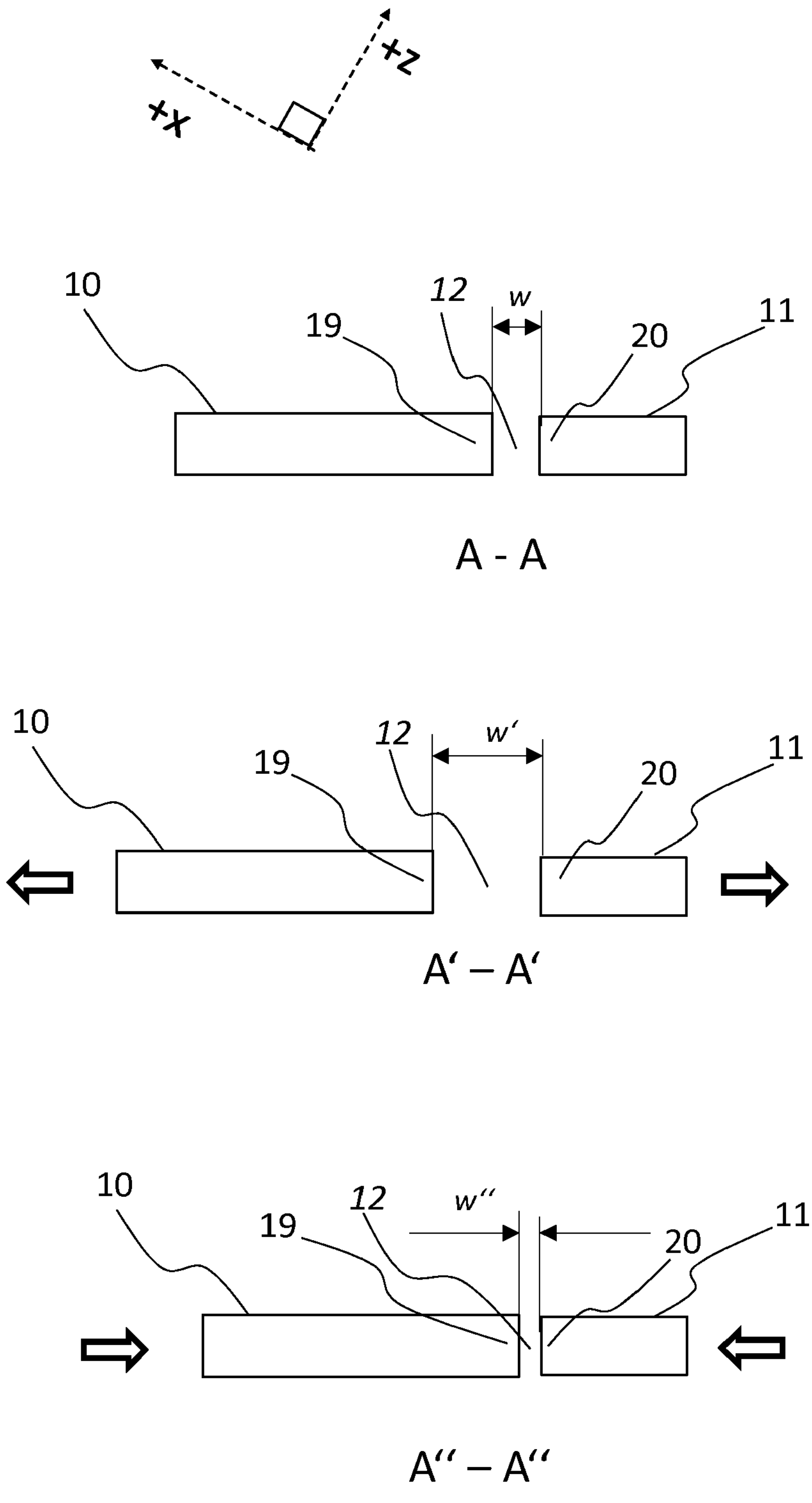


FIG 6

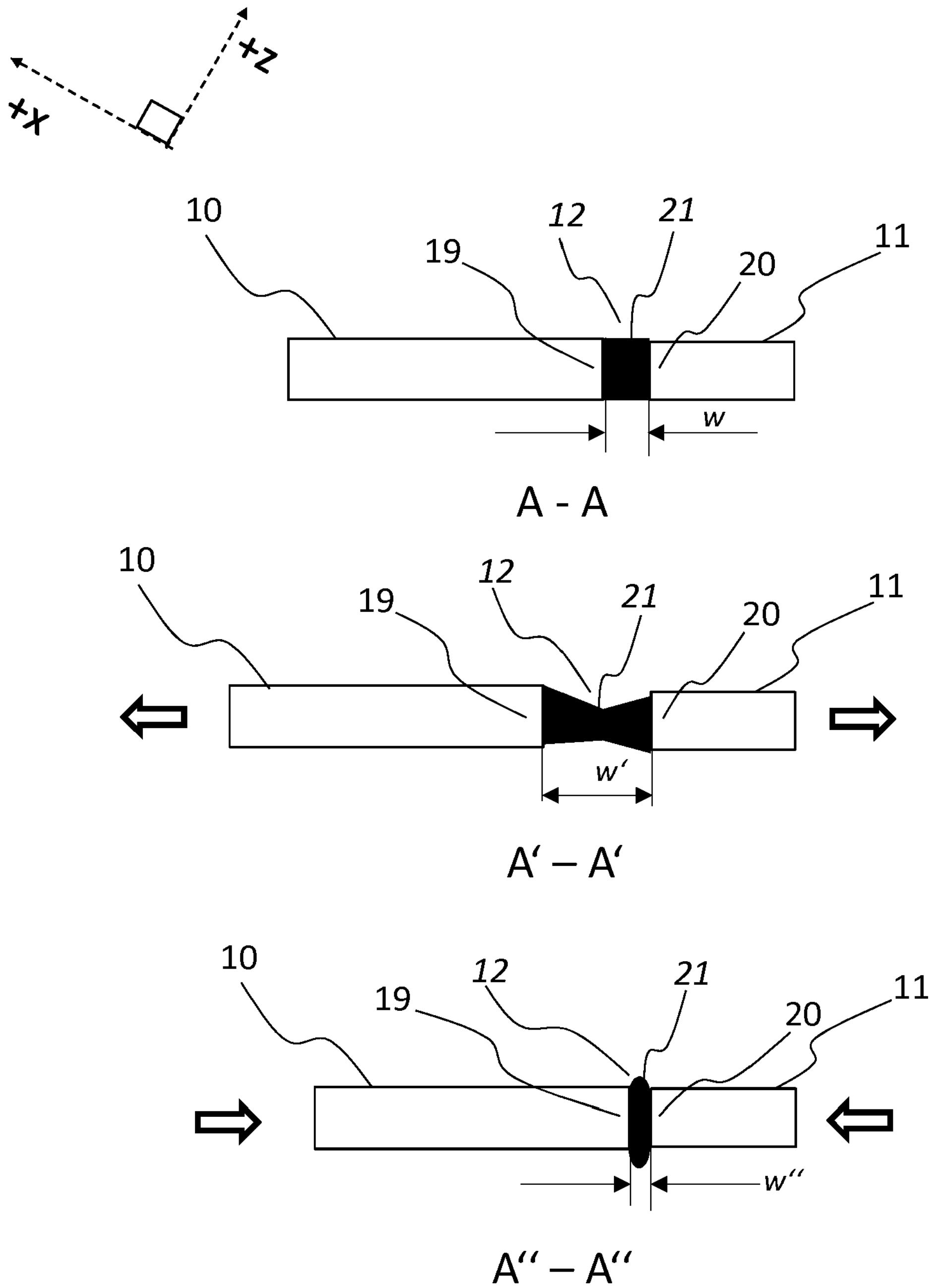


FIG 7

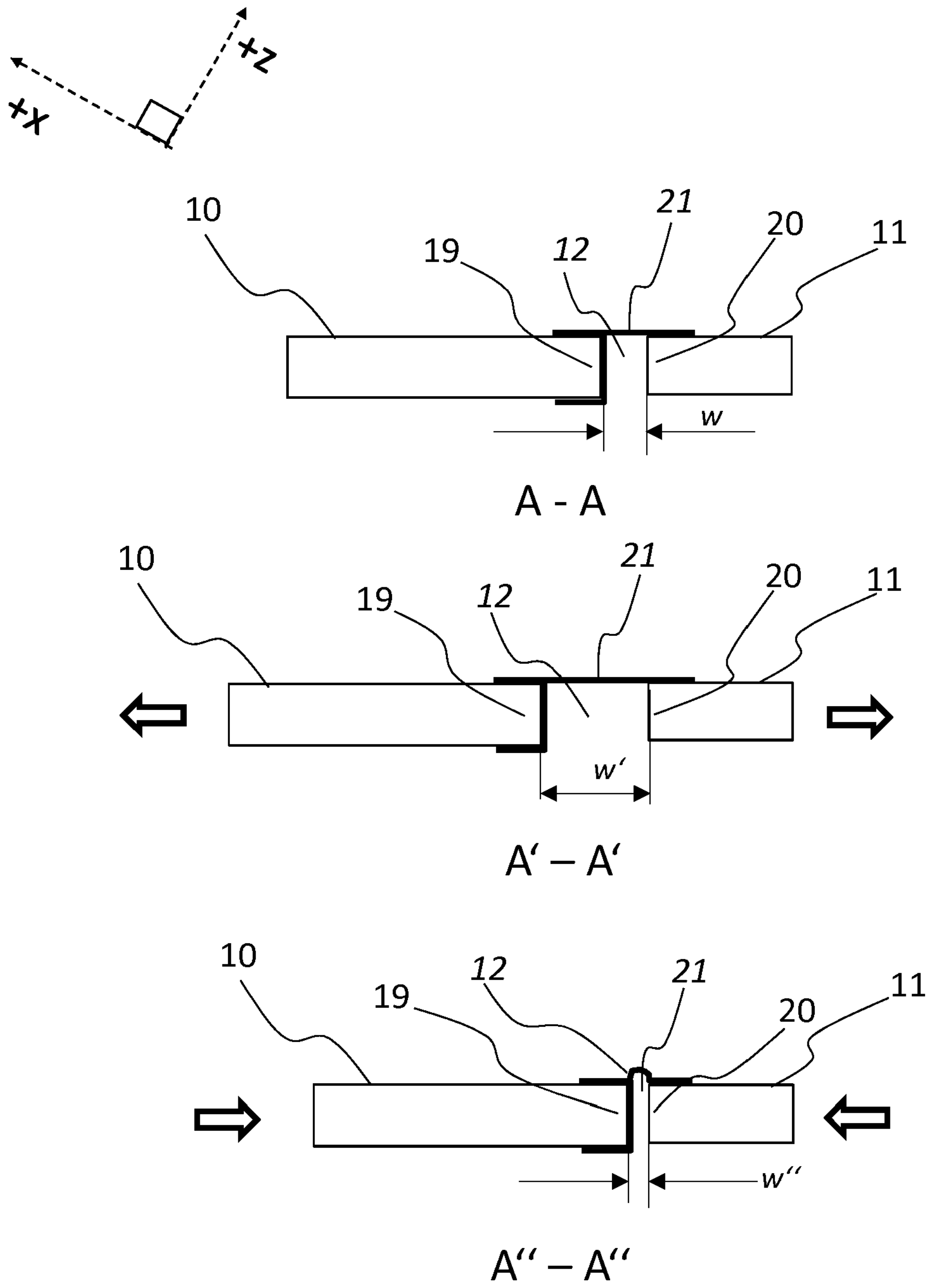
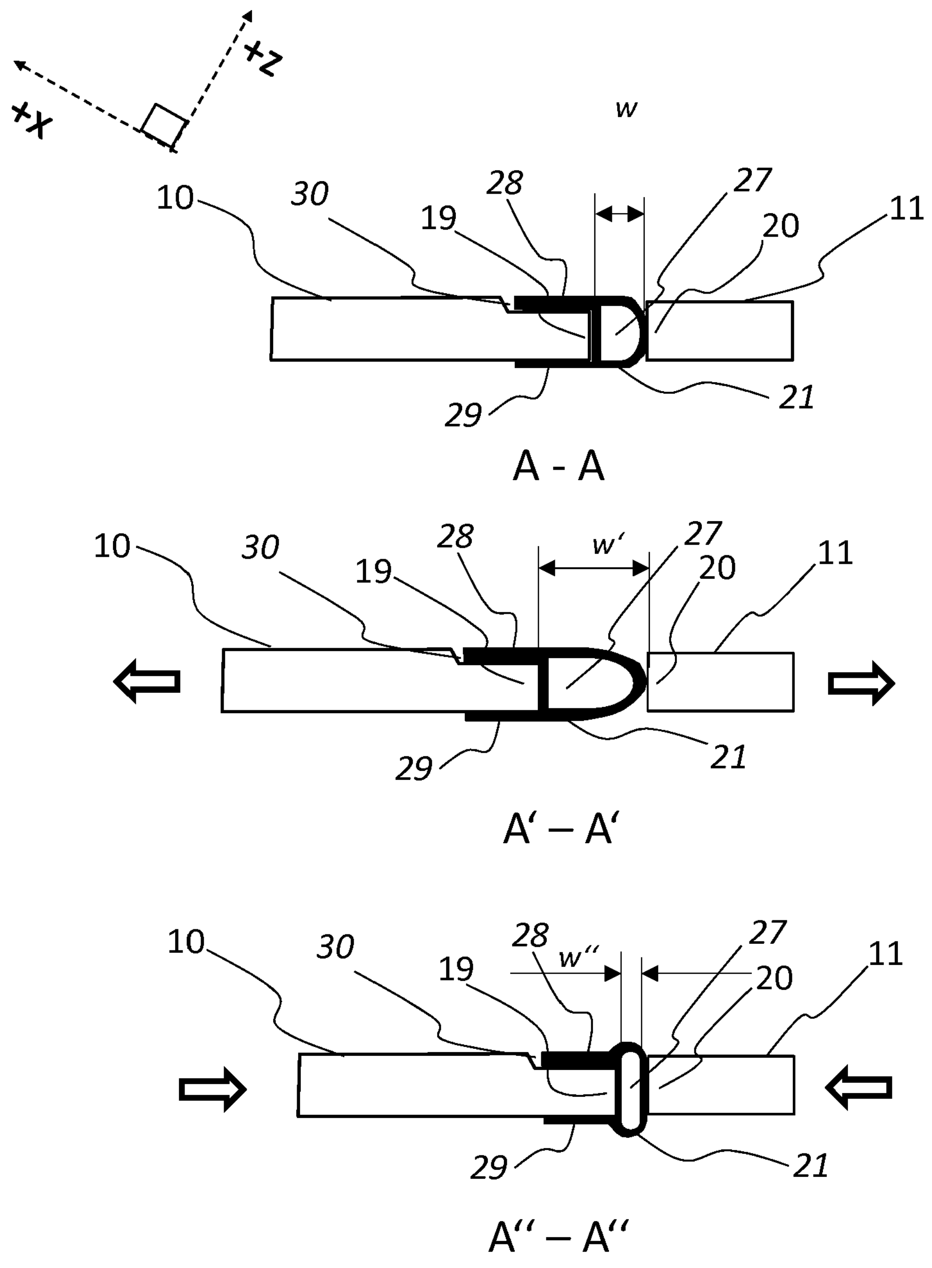


FIG 8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A'' – A''

FIG 9

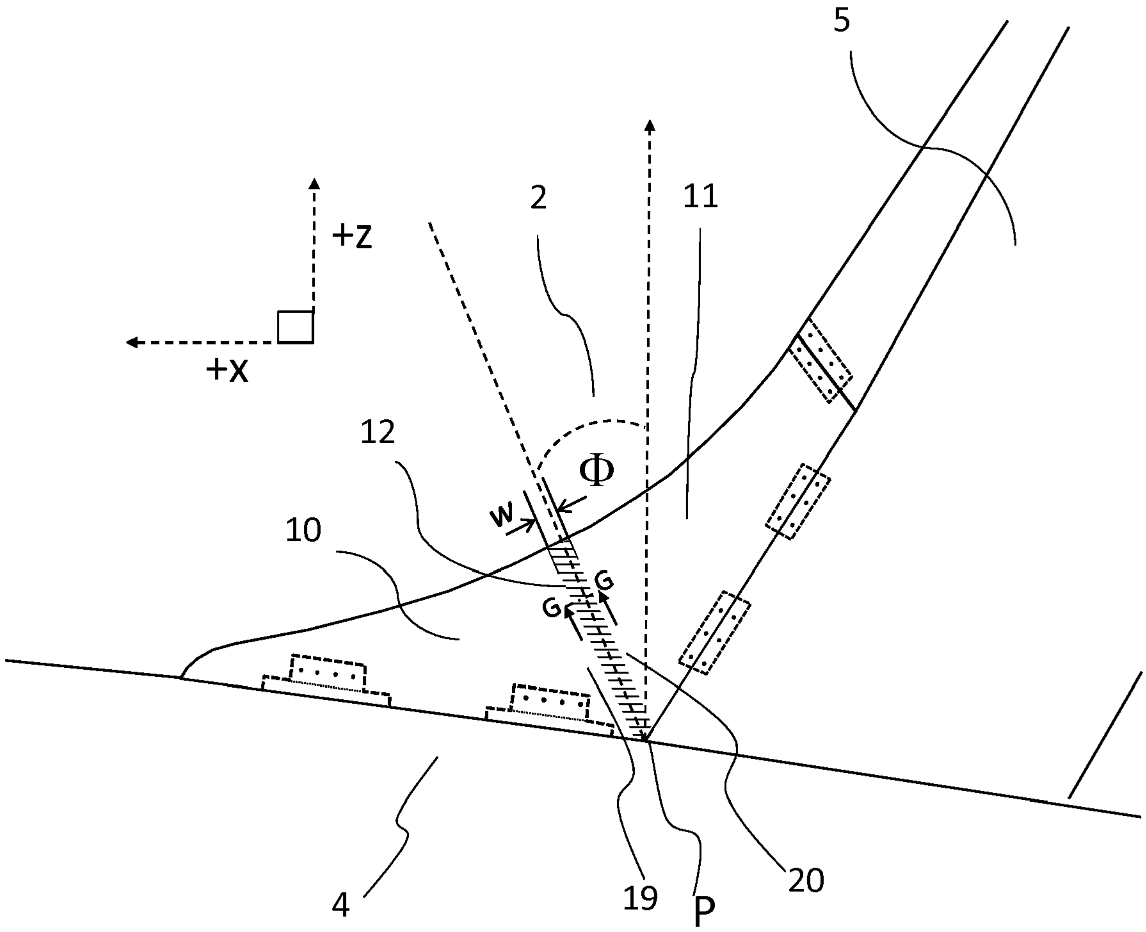

FIG 10

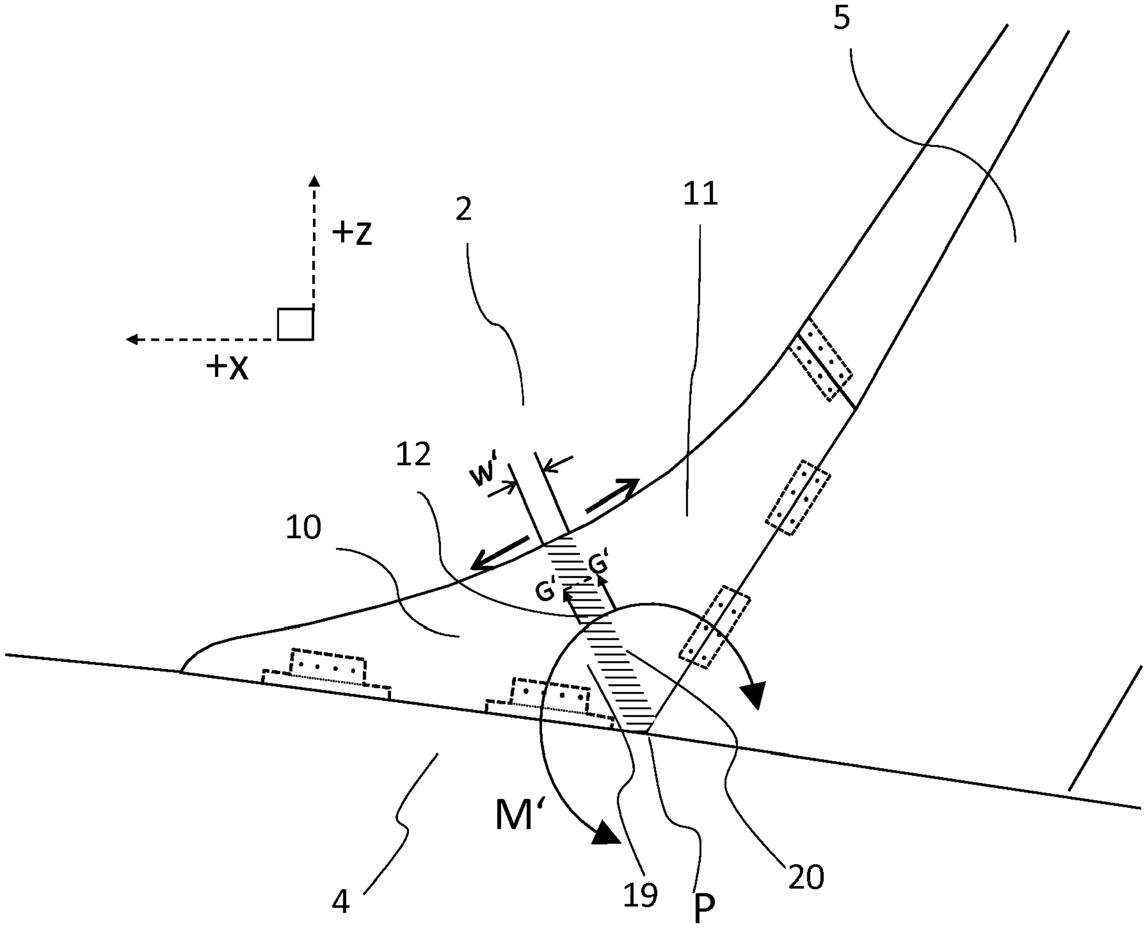

FIG 11

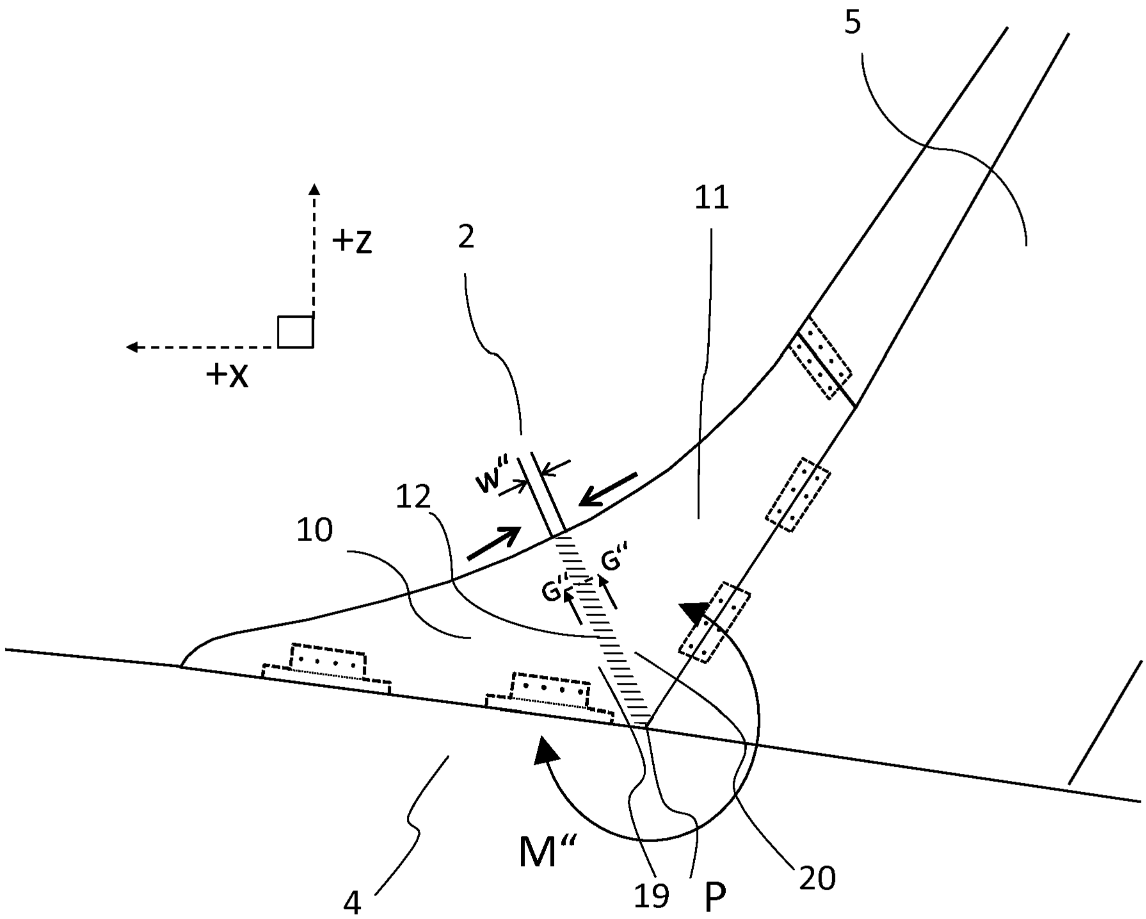

FIG 12

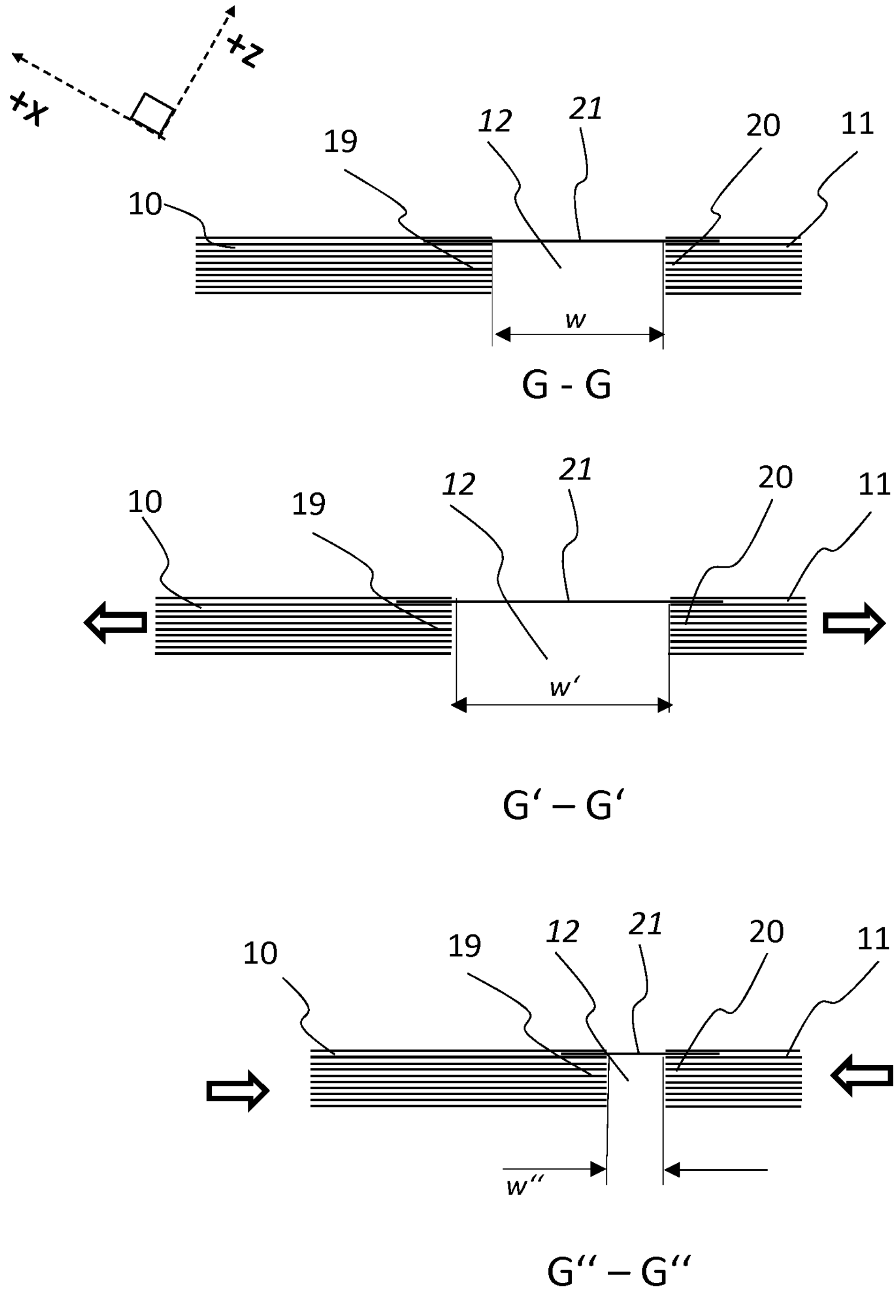

FIG 13

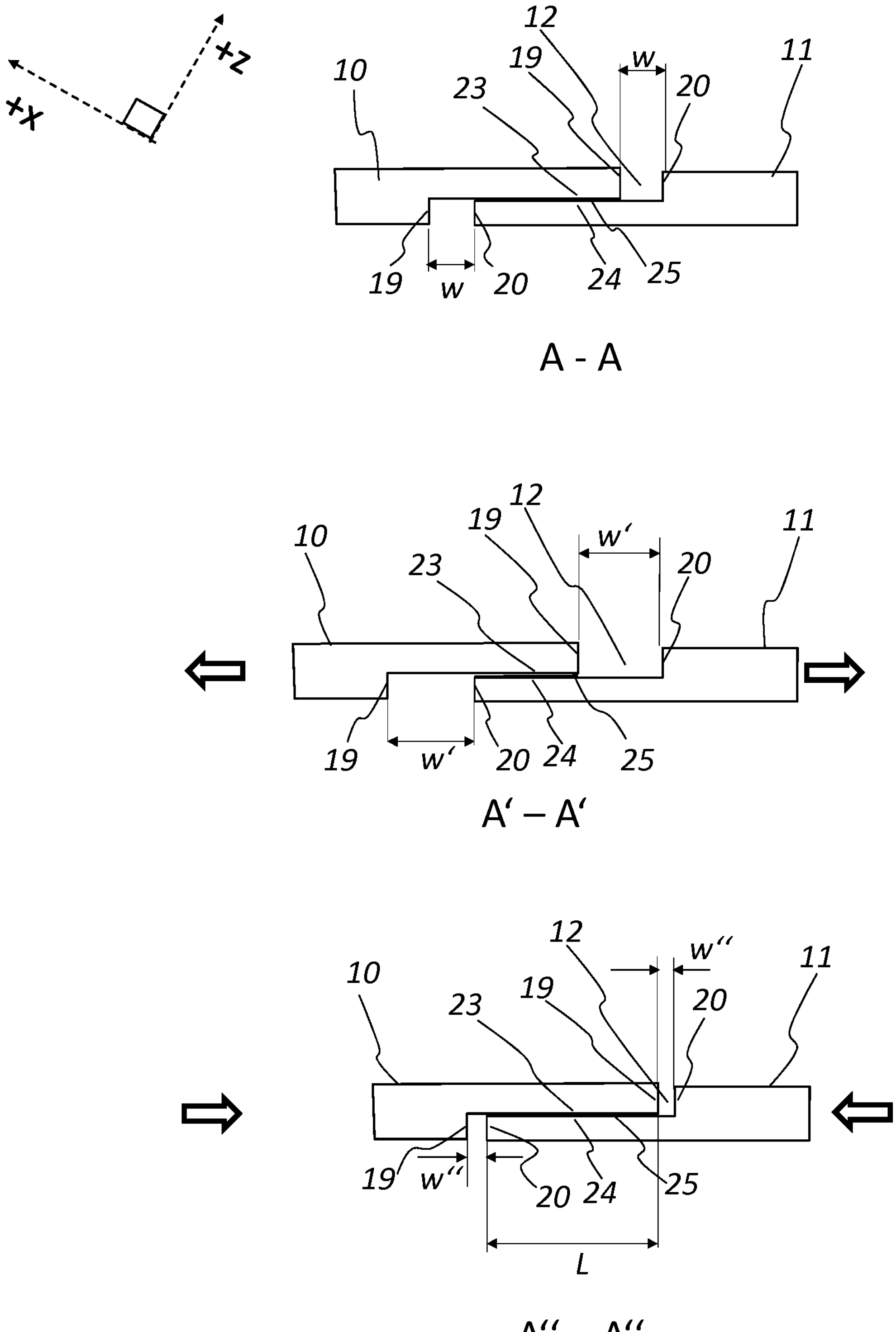
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FIG 14

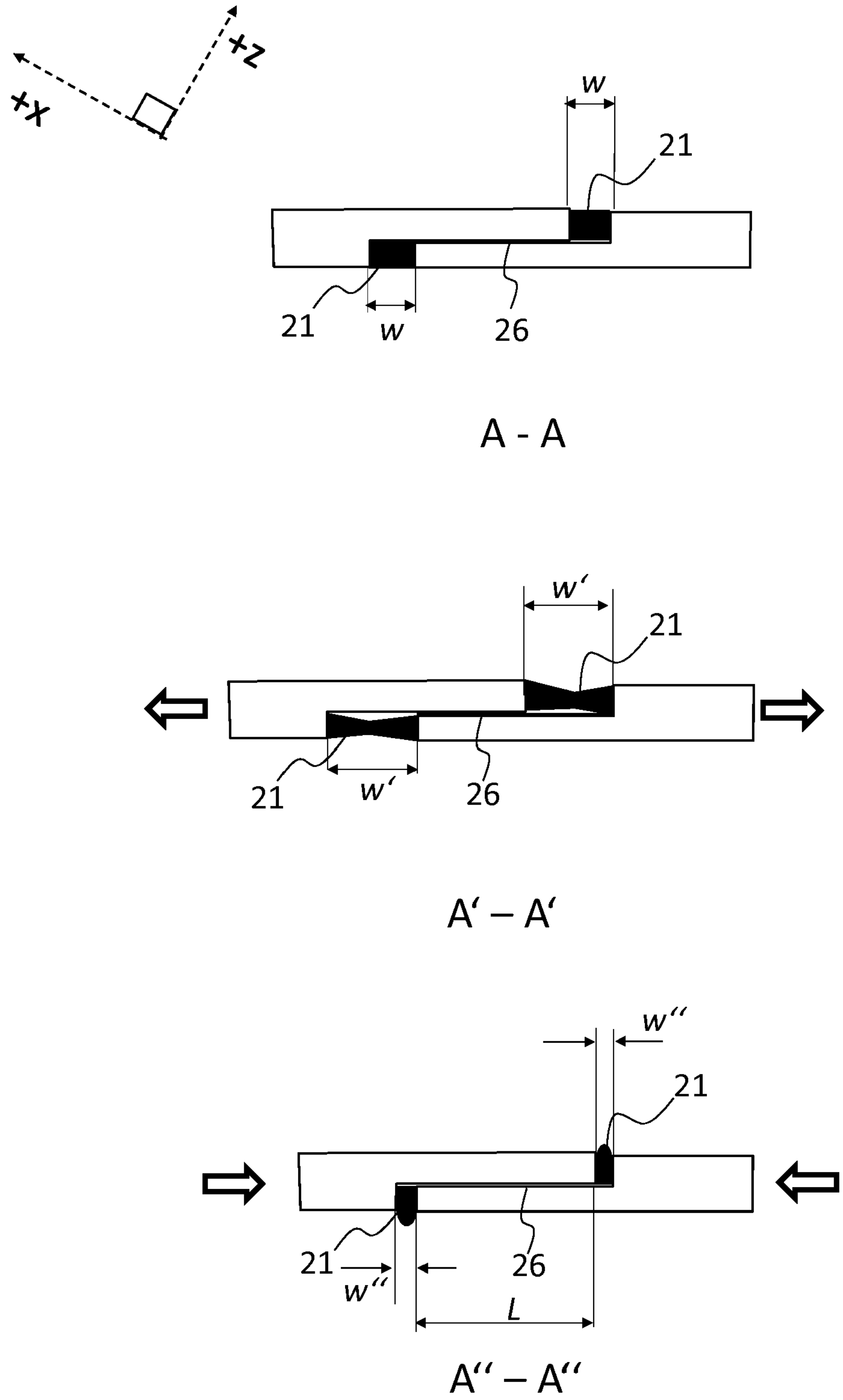

FIG 15

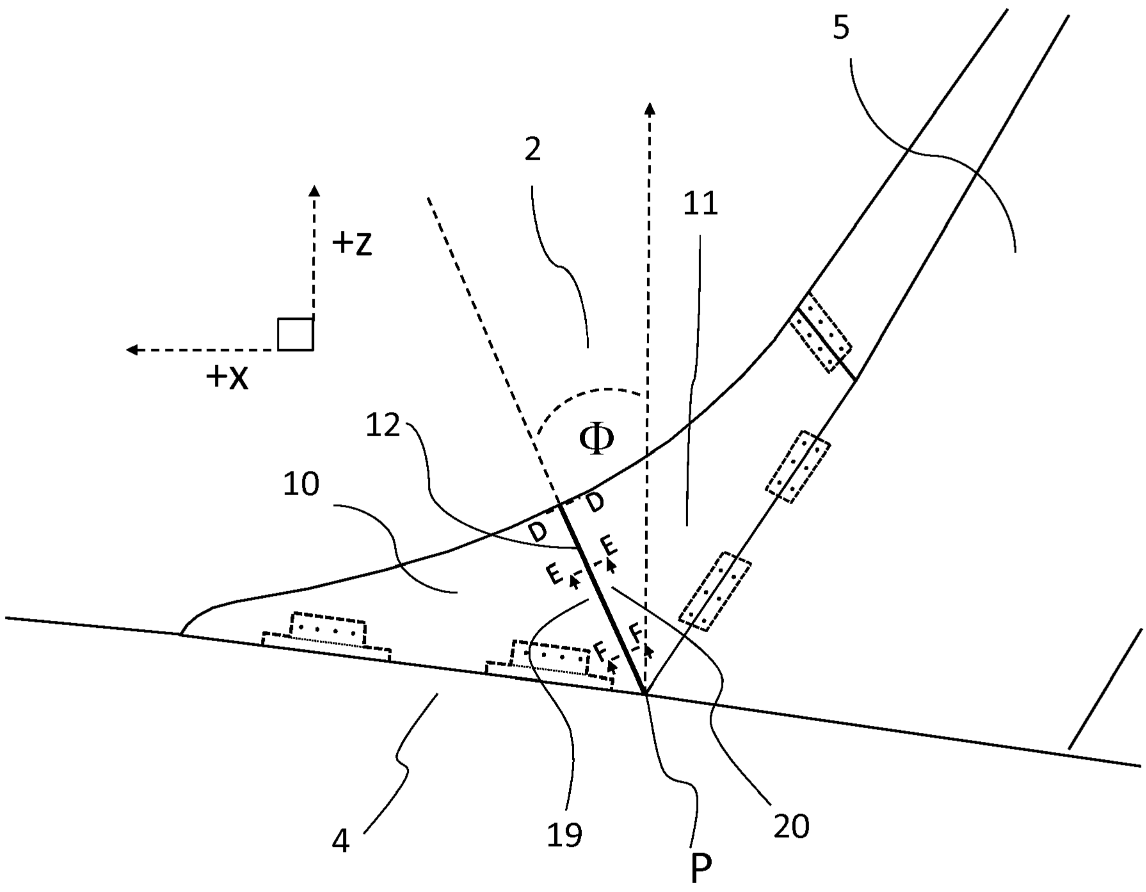

FIG 16

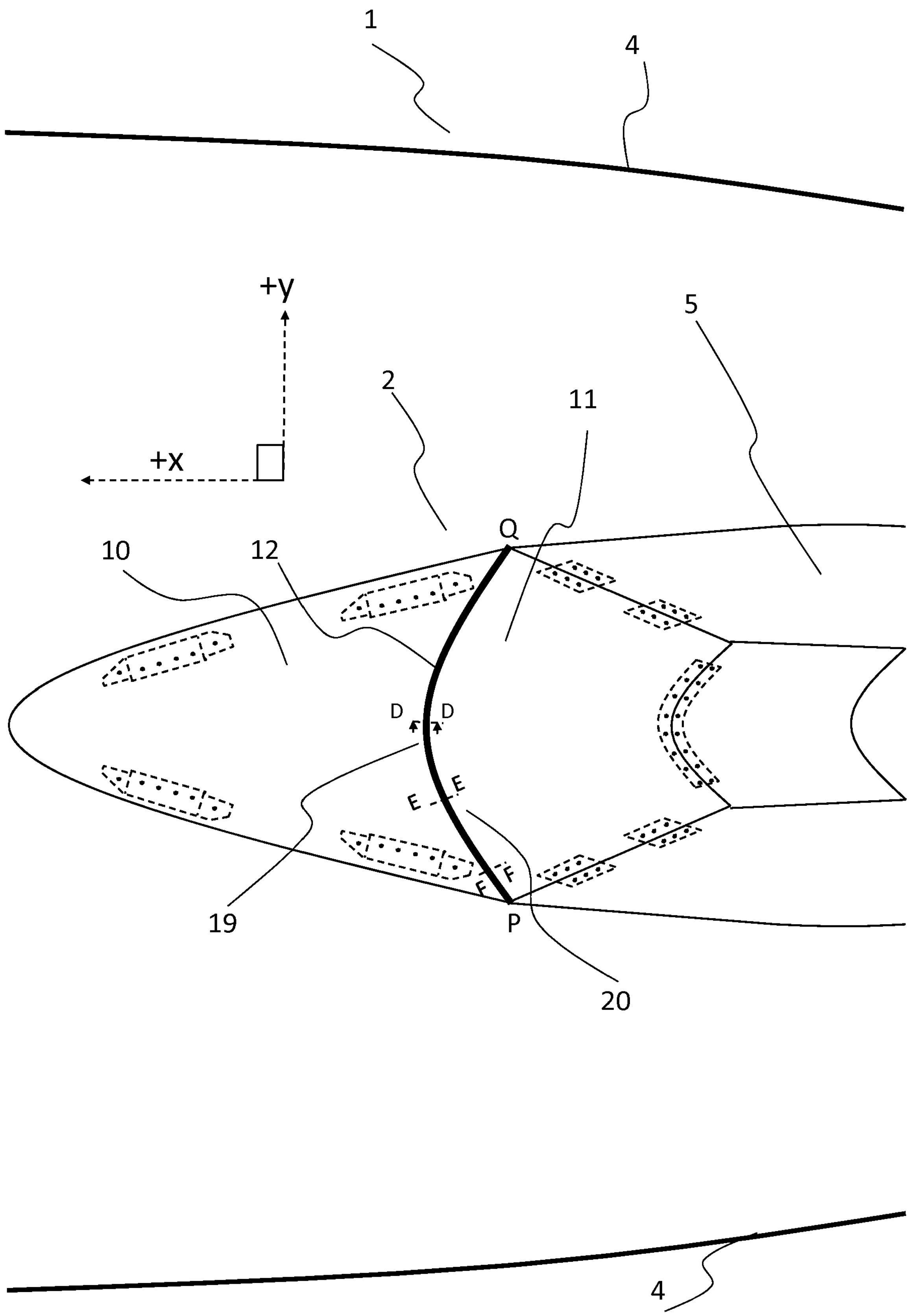

FIG 17

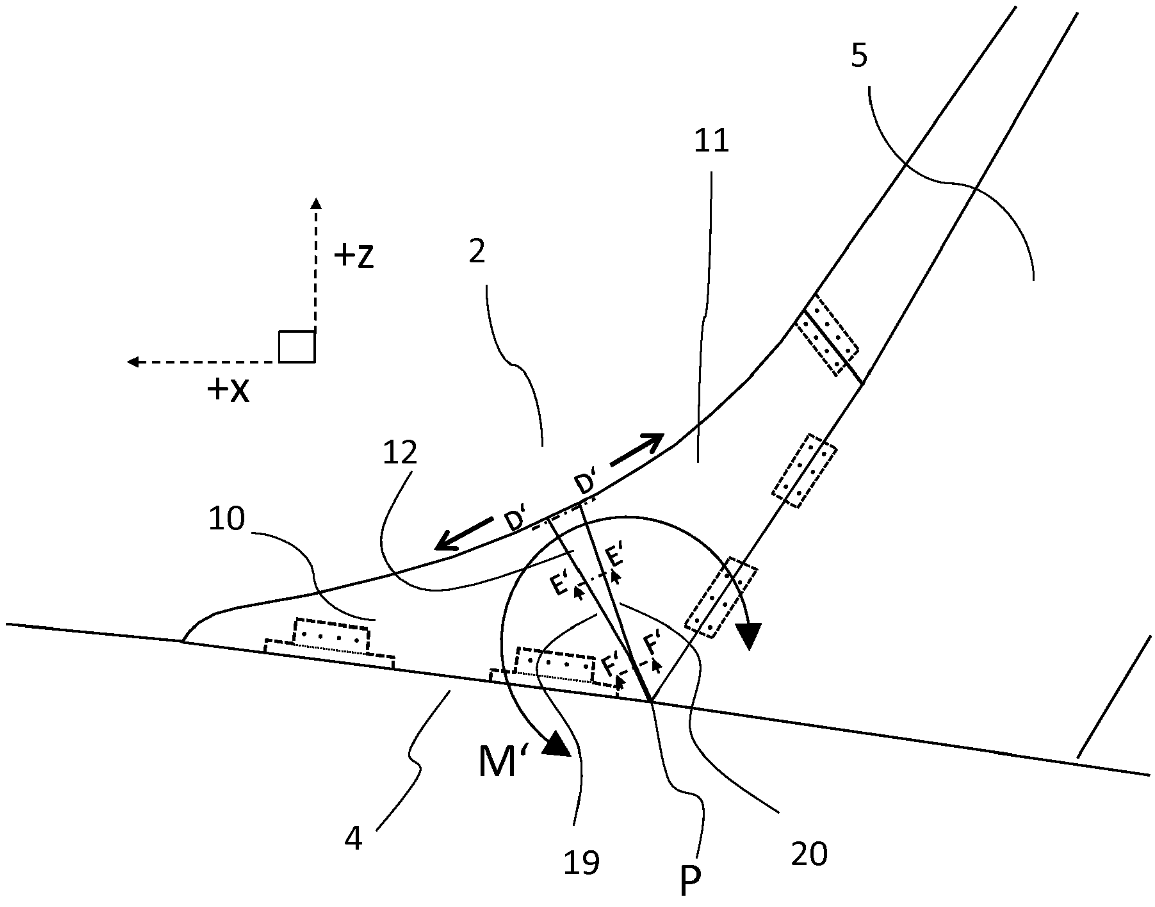

FIG 18

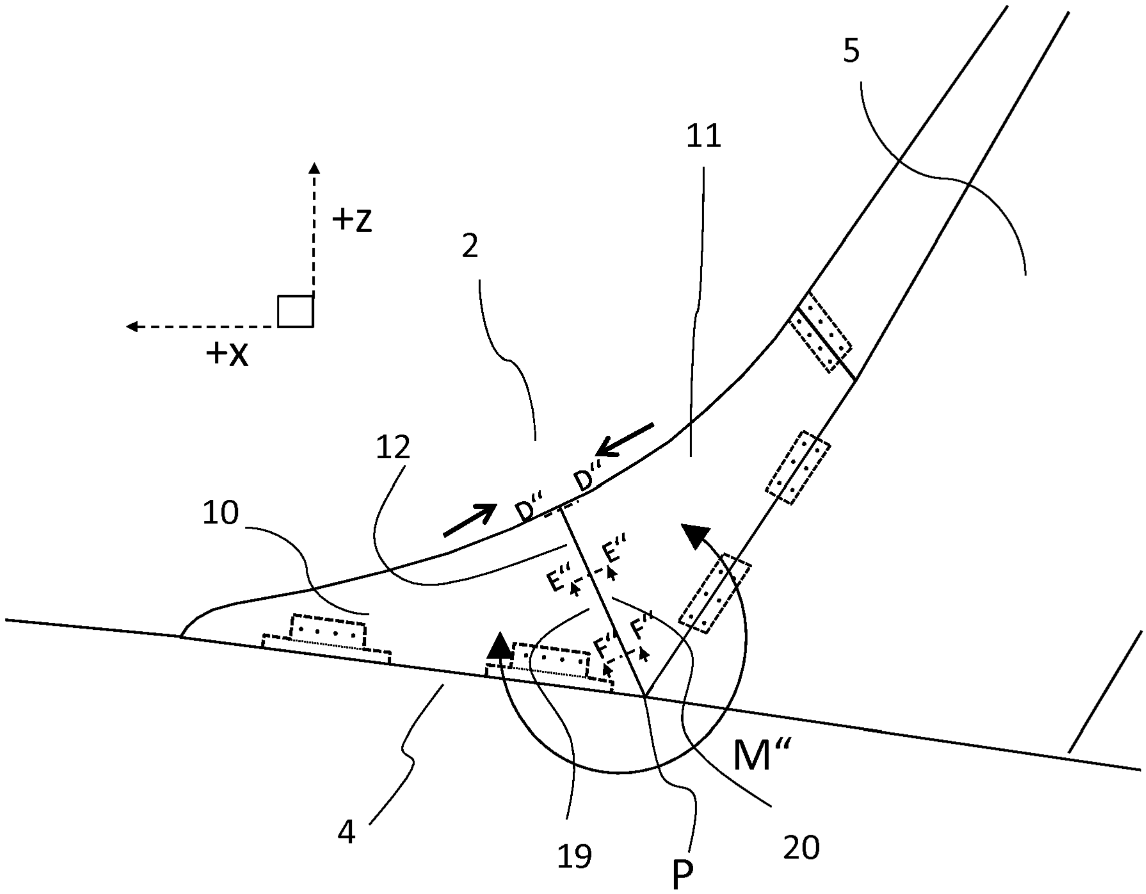

FIG 19

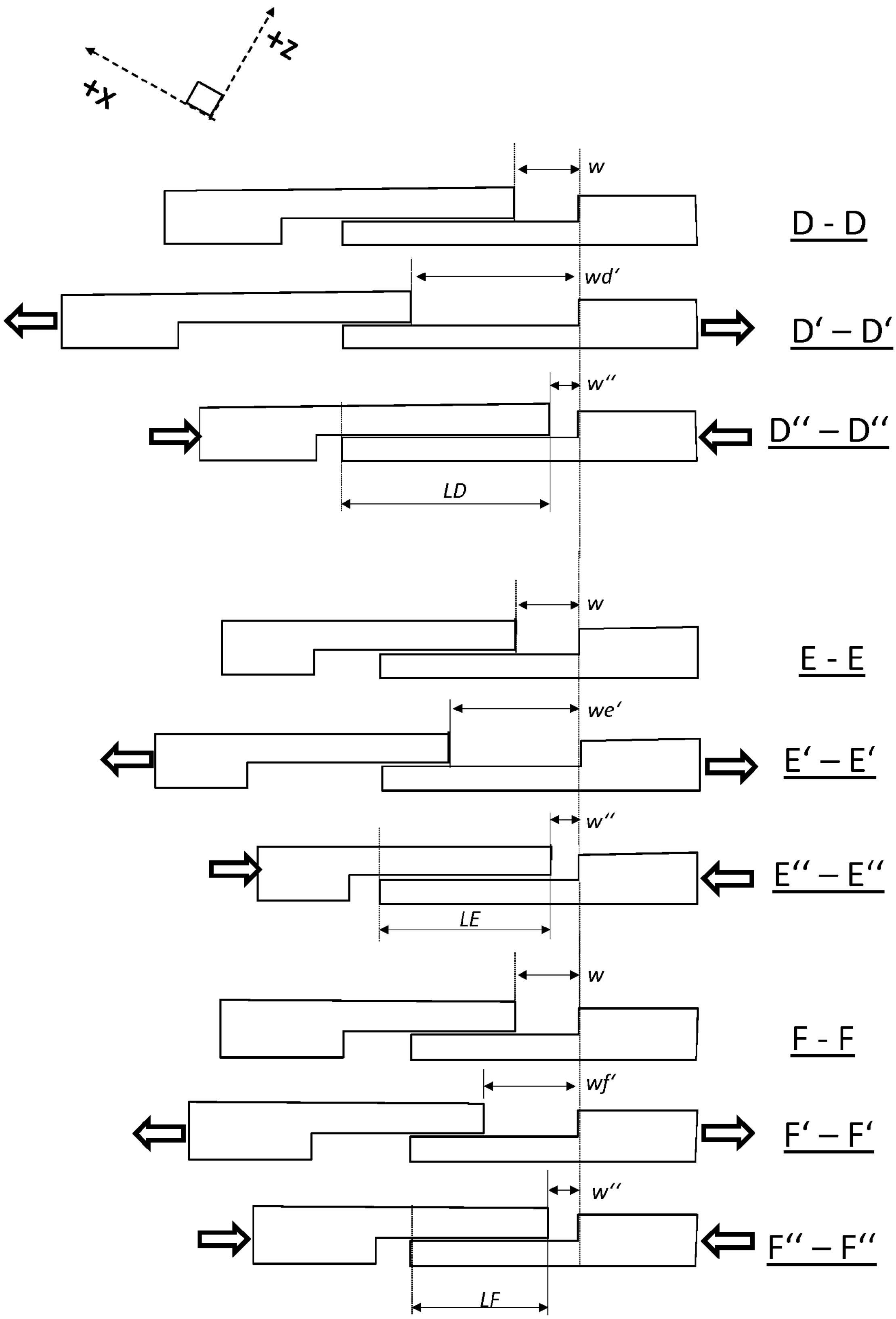

FIG 20

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EUROPEAN SEARCH REPORT

Application Number
EP 16 19 6833

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The present search report has been drawn up for all claims

3

Place of search	Date of completion of the search	Examiner
Munich	16 March 2017	Retucci, Adriano

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